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plasma-chemical etching operation of silicon substrates in the micro-electronic industry, are cleaned by passing them in an evacuated container over a reactant material in presence of an inert gas. A plasma is maintained between container and reactant material so that the latter is heated and its contact surfaces are constantly renewed.

ADVANTAGE - This requires less energy and less maintenance to clean the waste gases more efficiently. (0/1)

-3- (WPAT)

ACCESSION NUMBER	83-40254K/17
TITLE	Exhaust gas processing appts. for processing exhaust gas - including hydrogen sulphide, nitrogen cpds., etc. by arc discharge. NoAbstract
DERWENT CLASSES	E36 J01 Q73
PATENT ASSIGNEE	(SHIF) SHIN MEIWA IND CO LTD
PRIORITY	81.09.10 81JP-143556
NUMBERS	2 patent(s) 1 country(s)
PUBLICATION DETAILS	JP58045718 A 83.03.17 * (8317) 4p JP91009768 B 91.02.12 (9110)
APPLICATION DETAILS	81JP-143556 81.09.10
SECONDARY INT'L. CLASS.	B01B-053/32 B01D-053/32 F23G-007/06

103

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-4- (WPAT)

ACCESSION NUMBER	81-08977D/06
TITLE	Gas discharge reactor for removing toxic components etc. - comprises opposed electrode plates arranged in parallel and spray nozzles for atomising a liq. e.g. water
DERWENT CLASSES	J01
PATENT ASSIGNEE	(NIDS) NIPPON ELECTRON OPTICS LAB
PRIORITY	75.12.25 75JP-153944
NUMBERS	2 patent(s) 1 country(s)
PUBLICATION DETAILS	JP81001133 B 81.01.12 * (8106) JP52078176 A 77.07.01 (8106)
SECONDARY INT'L. CLASS.	B01D-019/08 B01D-053/34
ABSTRACT	JP81001133 B A device for discharging a gas flowing in a gas flow area is claimed. The discharged gas is used for removing harmful or dirty gas components. The device comprises opposed electrode plates arranged in parallel to form gas passages between them, and spray nozzles for atomising a liq. such as water, so that the gas passes through dry and then wet atmospheres discharge fields. (J52078176).

-5- (WPAT)

ACCESSION NUMBER	76-97075X/52
TITLE	Treatment of waste gas generated from semiconductor prodn. - by oxidising with oxygen or hydrogen peroxide in plasma generating surroundings
DERWENT CLASSES	E32 E36 J01 L03
PATENT ASSIGNEE	(FUIT) FUJITSU LTD
PRIORITY	75.05.07 75JP-053904
NUMBERS	1 patent(s) 1 country(s)
PUBLICATION DETAILS	JP51129868 A 76.11.11 * (7652)

102

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PTO 99-448

Japanese Kokai Patent Application
No. Sho 58[1983]-45718

EXHAUST-GAS PROCESSING APPARATUS

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UNITED STATES PATENT AND TRADEMARK OFFICE
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PATENT JOURNAL

KOKAI PATENT APPLICATION NO. SHO 58[1983]-45718

Intl. Cl.[3]:	B 01 D 53/32 53/34 F 23 G 7/06
Sequence Nos. for Office Use:	6825-4D 8014-4D 7367-3K
Application No.:	Sho 56[1981]-143556
Application Date:	September 10, 1981
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No. of Inventions:	1 (Total of 8 pages)

EXHAUST-GAS PROCESSING APPARATUS

[Hai gasu shori souchi]

Inventors:	Yukio Iwazaki Ken Yoshiwara
Applicant:	Shin Meiwa Industries Co., Ltd.

Claims /1*

1. An exhaust-gas processing apparatus provided with a tube with a gas introduction port formed at one end and a gas discharge port at the other end, with electrodes secured inside the tube with gaps therebetween, a circuit for applying voltage between the electrodes, and insulating oxidation catalyst bodies, with the above-mentioned electrodes comprising first electrodes with gas conduits formed in the external peripheral sections of their current-carrying bodies, as well as second electrodes with gas conduits formed in the internal peripheral sections of their current-carrying bodies.

2. The exhaust-gas processing apparatus according to Claim 1, in which there are at least three electrodes described above that are secured in such a manner that there are gaps therebetween, and moreover with the above-mentioned first electrodes and second electrodes being arranged in an alternating manner, and in the above-mentioned [sic] voltage-applying circuit, with a switching circuit being included that is adapted to perform switching and to apply voltage between progressively more distant electrodes between either of the electrodes located at the two ends of the above-mentioned tube and other electrodes.

3. The exhaust-gas processing apparatus according to Claim 1, in which the above-mentioned insulating oxidation catalyst bodies are produced in the form of porous plates and are interposed midway between the above-mentioned adjacent electrodes.

* [Numbers in the margin indicate pagination in the foreign text.]

4. The exhaust-gas processing apparatus according to Claim 1, in which the above-mentioned insulating oxidation catalyst bodies are produced in the form of porous plates and are interposed between the above-mentioned gas discharge port and the above-mentioned electrode adjacent thereto.

5. The exhaust-gas processing apparatus according to Claim 1, in which the above-mentioned insulating oxidation catalyst bodies are formed as insulating supports of the above-mentioned electrodes.

6. The exhaust-gas processing apparatus according to Claim 1, in which the above-mentioned current-carrying bodies are obtained by platinum electroplating.

7. The exhaust-gas processing apparatus according to Claim 1, in which the above-mentioned gas conduits of the above-mentioned electrodes are formed in a spiral shape.

8. The exhaust-gas processing apparatus according to Claim 7, in which the above-mentioned spiral gas conduits are formed so that the direction of their spirals is made alternatingly opposite for each of the above-mentioned adjacent electrodes.

Detailed explanation of the invention

This invention relates to an apparatus intended for the treatment of exhaust gases containing harmful and malodorous components, such as hydrogen sulfide, mercaptans, sulfur dioxide and other sulfur compounds, or ammonia, trimethylamine, and other nitrogen compounds, in a spark-discharge electric field. /2

Applications for an exhaust-gas processing apparatus converting exhaust gas containing the above-described harmful and

malodorous components into a harmless gas by introducing gas into an electric field wherein a spark discharge is carried out and electrochemically reacting it with the accompanying gases have previously been filed by the authors of Japanese Patent Application Nos. Sho 55[1980]-11178 and Sho 55[1980]-34337. Namely, they were constructed in such a manner that first electrodes with gas conduits formed in the external peripheral sections of their current-carrying bodies, as well as second electrodes with gas conduits formed in the internal peripheral sections of their current-carrying bodies, were secured so that there were gaps therebetween inside a tube with a gas introduction port formed at one end and a gas discharge port at the other end, with the above-mentioned exhaust gas to be processed converted into an innocuous gas by introducing it through the above-mentioned gas introduction port, causing it to cross a discharge electric field formed between the above-mentioned electrodes while passing through the above-mentioned gas conduits and being discharged from the above-mentioned gas discharge port, thereby causing the above-mentioned components in the exhaust gas to undergo dissociation and ionization, followed by oxidation by the oxygen in the accompanying gases.

In the case of the above-described processing apparatus, particularly if the apparatus was small (with a small diameter), exhaust-gas processing was carried out efficiently, but if it were large, the contact between the exhaust gas and the discharge spark became insufficient, and its processing performance deteriorated.

The invention was made by taking the above-described circumstances into consideration; its objective is to provide an exhaust-gas processing device constructed in such a manner that

due to providing insulating oxidation catalyst bodies in the above-mentioned tube of the exhaust-gas processing apparatus utilizing the above-described electrodes, the processing performance does not deteriorate even if the processing apparatus is large. A detailed explanation of application examples is provided hereinbelow.

First of all, detailed explanations are provided regarding Application Examples 1-7.

Key (1) denotes a heat-resistant insulating tube with a gas introduction port (1*a*) formed at one end, and with a gas discharge port (1*b*) formed at the other end.

Keys (2-5) denote four electrodes in an application example; they are secured inside the tube (1) so that there are gaps therebetween. Among these, (2) and (4) are first electrodes with right-hand spiral gas conduits formed in the external peripheral sections of their current-carrying bodies, with each of them consisting of cylindrical current-carrying bodies (2*a*, 4*a*), insulating oxidation catalyst bodies (2*c*, 4*c*) provided integrally with the external peripheral sections of these current-carrying bodies (2*a*, 4*a*), serving as supports for the electrodes (2, 4) with respect to the tube (1), and having right-hand spiral gas conduits (2*b*, 4*b*) formed in the internal peripheral sections, and insulators (insulating oxidation catalyst bodies) (2*d*, 4*d*) integrated with the internal peripheral sections of the current-carrying bodies (2*a*, 4*a*). Also, (3) and (5) are second electrodes with left-hand spiral gas conduits formed in the internal peripheral sections of their current-carrying bodies, with each of them consisting of cylindrical current-carrying bodies (3*a*, 5*a*), insulators (insulating oxidation catalyst bodies) (3*c*, 5*c*) provided integrally with the internal peripheral

sections of these current-carrying bodies (3*a*, 5*a*) and having left-hand spiral gas conduits (3*b*, 5*b*) formed in the external peripheral sections, and insulating oxidation catalyst bodies (3*d*, 5*d*) provided integrally with the external peripheral sections of the current-carrying bodies (3*a*, 5*a*) and serving as supports for the electrodes (3, 5) with respect to the tube (1).

The electrodes (2-5) are provided in a series with constant gaps therebetween, as shown in Figure 1, in such a manner that the first electrodes (2, 4) and second electrodes (3, 5) are arranged in an alternating manner. As a result, the gas conduits (2*b*-5*b*) are set in an opposite direction for each adjacent electrode.

In addition, in the current-carrying bodies (2*a*-5*a*), their surface of [illegible] or copper is electroplated with platinum. Also, in this application example, the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*) consist of a crystalline clay mineral and zinc oxide, as well as manganese oxide, a crystalline clay mineral and zinc oxide, or a crystalline clay mineral and manganese oxide. Clay minerals, with the exception of allophane, which is amorphous, are used as the above-mentioned crystalline clay minerals. Generally speaking, commercially available kaolin, montmorillonite, and zeolite are preferable. Also, as for zinc oxide, there are no particular requirements concerning its purity, and commercially available ZnO is used. Furthermore, for manganese oxide, MnO_2, Mn_2O_3, and other common oxides are used, and they may contain a small amount of impurities. When a catalyst is formed by mixing the above-described eight components, not less than 20 wt% of the metal oxides (such as ZnO, MnO_2) and not more than 80 wt% of the crystalline clay minerals are mixed together; catalyst bodies (2*c*-5*c*) and (2*d*-5*d*)

are molded in their respective shapes, followed by sintering at 200-600°C.

Key C designates a circuit intended for applying voltage between either of the electrodes (2-5) at both ends of the tube /3 (1) (electrode (2) on the side of the introduction port (1*a*) in the application example) and other electrodes (3-5). The configuration of circuit C is explained hereinbelow.

(10) is a commercial alternating-current power supply.

(11) is a step-up transformer, namely, a leakage transformer with a primary side of 100 V and a secondary side of 18,000 V.

(12) is a main switch.

(13) is a timing relay, with (13*b*) being the b contact point of its timing return, and with its preset operating time set to several seconds.

(14) is a timing relay, with (14*a*) being the "a" contact point of its timing operation, (14*b*) being the "b" contact point of its timing return, and its timing operation time set to double the timing operation time of relay (13).

(15) is an electric current detector.

(16) is a relay, with (16*b*) being its "b" contract point.

(17) is a counter circuit, which is composed of (17*a*-17*e*) explained hereinbelow.

(17*a*) is a counter, which generates a high level output when a high level input occurs four times.

(17*b*) is a signal conversion circuit, which is a well-known circuit constructed so as to rectify an alternating signal input, converting it to an appropriate direct-current signal by adjusting the level and using it as input for the counter (17*a*).

(17*c*) is a relay circuit, which is a circuit of a well-known construction intended for closing the return of relay (16) using the high level output of the counter (17*a*).

(17*d*) is an initial reset circuit, which is a well-known circuit constructed so as to reset the counter (17*a*) to a no-count state when the power supply for the counter circuit (17) is cut off once, then restored again.

(17*e*) is a power supply circuit, which is a well-known circuit constructed so as to rectify the alternating power supply input to the counter circuit (17) and to obtain a direct-current power supply suitable for the operation of the counter (17*a*) by adjusting the level.

(18) is a relay, with (18*a*) being its contact point (*a*) and (18*b*) its contact point (*b*).

(19) is a solenoid (normally protruding type) and (20) is a normally open switch interlocked with the solenoid (19).

(21) is a solenoid (normally protruding type) and (22) is a normally open switch interlocked with the solenoid (21).

The above constituent elements (10-22) are connected in the manner shown in Figure 1, so that circuit (C) is formed.

In addition, the solenoids (19, 21) and switches (20, 22) are coupled in the manner shown in Figures 6 and 7. Namely, one end of levers (20*b*, 22*b*), which have slits (20a, 22*a*), is vertically supported on a horizontal plate (F) by shaft supports (20*c*, 22*c*), with the rods (19*a*, 21*a*) of the solenoids (19, 21) secured by (19b, 21b) to the slits (20*a*, 22*a*). Male terminals (20*d*, 22*d*) then protrude at the other end of the levers (20*b*, 22*b*), whereas female terminals (20*e*, 22*e*), which correspond thereto, protrude on the plate (F). Also, insulating plates (23, 24) (asbestos plates in the application example) are suspended in

the range of rotation of the levers (20*b*, 22*b*) using horizontal shafts (23*a*, 24*a*). The levers (20*b*, 22*b*) are then normally in the position indicated with a solid line in Figures 6 and 7 due to being biased by the force of springs housed inside the solenoids (19, 21), so that terminals (20*d*) and (20*e*), and (22*d*) and (22*e*) are in an open state. Also, the insulating plates (23, 24) are suspended between the two terminals (20*d*) and (20*e*) in such a manner that they shield (22*d*) from (22*e*).

A changeover circuit (S) is then formed using relays (13, 14) and their contact points (13*b*, 14*b*), solenoids (19, 21), one of the elecrodes on either side of the tube (1) (electrode 2 in the application example) and electrodes 3-5 as follows: and switches (20, 22) interlocked therewith so as to apply voltage by progressively switching between initially electrodes (2-3), then (2-4), and finally (2-5).

The operation of this application example is described hereinbelow.

When the gas to be processed is introduced from the gas introduction port (1*a*), the exhaust gas passes through the spiral conduits (2*b*-5*b*) inside the tube (1) in the direction indicated by arrows in Figure 1, then discharged from the discharge port (1*b*). Because, in the process, the direction of the spirals of the conduits (2b-5b) changes to the opposite for each of the adjacent electrodes, that is, either from right-hand to left-hand or from left-hand to right-hand, the exhaust gas swirls in the opposite direction when passing through each of the conduits (2*b*-5*b*).

Thus, when the switch (12) in the circuit (C) is connected, /4
the relays (13, 14) and solenoids (19, 21) are put in operation. The rods (19a, 21*a*) of the two solenoids (19, 21) sink in against

the force of the springs inside the above-mentioned solenoids (19, 21), the levers (20*b*, 22b) move to the position indicated with a two-dot chain line in Figures 6 and 7, the terminals (20c, 22c) are caused to come in contact with terminals (20d) and (20e), and the terminal (22*d*) is caused to come in contact with the terminal (22*e*), so that switches (20, 22) are closed. At such a time, both terminals (20d, 22*d*) or relays (20*b*, 22*b*) come in contact with the insulating plates (23, 24) and push said insulating plates (23, 24) upward around the shafts (23a, 24a) in the manner shown with an alternating long and short dash line in Figure 7. High voltage is then applied between current-carrying bodies (2a-3*a*), (2*a*-4*a*), and (2*a*-5*a*), so that a discharge takes place on part of the facing surfaces of current carrying bodies (2a, 3a). This discharge is formed over the entire periphery of the facing surfaces of the current-carrying bodies (2a, 3*a*) because as the above-described exhaust gas passes through the conduit (2*b*) of the electrodes (2) and comes out rotating in the right-hand direction, the discharge point performs right-hand rotation and thus creates a left-rotating flame curtain of discharge sparks. For this reason, the exhaust gas that has been discharged from the conduit (2*b*) reliably crosses the above-mentioned flame curtain and enters the conduit (3*b*) of the electrode (3). In the process, the components in the exhaust gas undergo dissociation, ionization, and gas discharge reactions.

Upon the lapse of the preset operating time (several seconds) of the relay (13) the contact point (13*b*) is disconnected and the solenoid (19) is brought to a nonoperating mode, so that the rod (19*a*) protrudes under the action of the force exerted by the spring inside the solenoid (19). The lever (20*b*) is rotated to the position shown with a solid line in

figures 6 and 7, and the switch (20) is disconnected. At such a time the insulating plate (23) is brought in a suspended state, as shown in Figures 6 and 7 with a solid line, under the action of gravity, so that terminals (20*d*) and (20e) are disconnected from each other. Thus, no discharge takes place between the terminals (20*d*) and (20e) due to high voltage.

Next, when the above-described switch (20) is brought to the open state, a discharge is carried out between the current-carrying bodies (2*a*-4*a*) in the same manner as described above by the high voltage applied between the electrodes (2-4). However, because the electrode (3) is located between the electrodes (2-4), the electrodes (2-3), and electrodes (3-4), a discharge is carried out and respective flame curtains are formed, as described above, over the entire periphery of the facing surfaces of the current-carrying bodies (2*a*) and (3*a*) as well as (3*a*) and (4*a*) which constitute the electrodes. In addition, because the discharge point performs left-hand rotation between the current-carrying bodies (3*a*) and (4*a*), the flame curtain performs left-hand rotation. Thus, the exhaust gas that has been discharged from the conduit (3*b*) of the electrode (3) crosses a left-rotating flame curtain between the current carrying bodies (3*a*-4*a*) and enters the conduit (4*b*) of the electrode (4). The components in the exhaust gas that have not reacted between the electrodes (2-3) are subjected to dissociation and ionization between the electrodes (3-4).

Next, upon the lapse of the preset operating time of the relay (14) (which is several seconds after the lapse of the preset operating time of relay (13)), the contact point (14*b*) is disconnected, and the solenoid (21) is brought to the nonoperating state, so that the rod (21*a*) protrudes under the

action of the force exerted by the spring inside the solenoid (21), the lever (22*b*) is rotated to the position indicated by a solid line in Figures 6 and 7, and the switch (22) is disconnected. At such a time the insulating plate (24) assumes a suspended position as shown with a solid line in Figures 6 and 7 and terminals (22*d*) and (22e) are disconnected from each other. Thus, no discharge takes place between the terminals (22*d*) and (22e) under the action of high voltage.

Next, when the above-mentioned switch (22) is disconnected, discharge is carried out between the current carrying bodies (2*a*-5*a*) in the same manner as described above based only on the high voltage applied between the electrodes (2-5). However, because electrodes (3, 4) are located between the electrodes (2-5), (2-3), (3-4), and (4-5), discharge is carried out and respective flame curtains are formed, as described above, over the entire periphery of the facing surfaces of the current-carrying bodies (2a, 3a, 4a, 5*a*), which constitute the electrodes. In addition, because the discharge point performs a right-hand rotation between the current-carrying bodies (4*a*) and (5*a*), the flame curtain performs a right-hand rotation as well. Thus, the exhaust gas emerging from the conduit (4b) of the electrode (4) crosses a right-rotating flame curtain between the current-carrying bodies (4*a*-5*a*) and enters the conduit (5*b*) of the electrode (5), so that the components of the exhaust gas that have not reacted between the electrodes (2-3) and (3-4) are subjected to dissociation and ionization between the electrodes /5
(4-5).

As was described above, the exhaust gas is continuously introduced into successive spark discharge fields and the components in the exhaust gas are subjected to dissociation and

ionization in a reliable manner by providing extremely good contact with the discharge spark, so that gas discharge reactions are carried out in an extremely efficient manner. Moreover, because the exhaust gas changes its rotation to the opposite direction when passing over the conduits (2*b*-5*b*), the contact between the discharge spark and the exhaust gas is made even better, and the above-mentioned dissociation and ionization are made even more efficient.

Upon the lapse of the preset operating time of the relay (14), the contact point (14*a*) is closed, the relay (18) operates based on the detection output of the detector (15), and the contact point (18*a*) is closed, with the relay (18) being brought into a self-holding state, while the contact point (18*b*) is opened, and with power supply to relays (13) and (14) being interrupted.

When the above-mentioned flame curtain is extinguished and discharge is interrupted because of changes in the gas flow rate or for other reasons, the output of the detector (15) disappears, with the relay (18) being brought to the nonoperating state. For this reason, the contact point (18*b*) is closed, with relays (13) and (14) operating again and discharge being carried out again in the above-described manner.

In addition, when the initial discharge was carried out, the detection output of the detector (15) was input in the counter circuit (17), and the counter (17*a*) carried out the first count, followed by a second count when discharge was resumed again after having been extinguished. Furthermore, even when the discharge stops, in the same manner as described above, an operation that resumes the discharge, and the counter (17*a*) carries out a third count. When the discharge stops after the third

discharge-initiating operation has been carried out, in the same manner as described above, the output of the detector (15) disappears, the relay (18) is brought to a nonoperating state and, for this reason, the contact point (18*b*) is brought to a closed state. As soon as the relays (13) and (14) operate, the detector (15) performs a fourth current detection operation. When its output is input to the counter circuit (17), the counter circuit (17) receives input for the fourth time. For this reason, the counter (17*a*) carries out a fourth count and supplies a high level output to the relay circuit (17*c*), so that the relay circuit (17c) supplies an output that brings the relay (16) to a nonoperating state to the relay (16) [sic]. Therefore, the contact point (16*b*) is brought to an open state, and most of the circuit (C) is brought to a nonenergized state, due to which the above-described automatic discharge-initiating operation stops.

After turning the switch (12) off, the causes of the cessation of discharge are investigated and appropriate measures are taken, and the switch (12) is turned on again. The counter circuit (17) returns to the clear state as a result of the operation of the initial reset circuit (17*d*), and the circuit (C) carries out the discharge-initiating operation in the same manner as described above.

Sulfur atoms ionized by the above-described discharge bond to the accompanying oxygen, forming sulfur trioxide, and nitrogen atoms become nitrogen gas, which is discharged from the discharge port (1*b*). Because the sulfur trioxide produced in the processing of exhaust gas containing sulfur compounds is harmful, malodorous components are easily converted into sulfuric acid by bonding to water. If the gas discharged from the discharge port (1*b*) is mixed with water, it is released into the atmosphere as a

harmless agent. Also, nitrogen compounds can be released into the atmosphere without modification.

In addition, during the above-mentioned discharge, the temperature inside the tube (1) increases due to the release of heat energy and, correspondingly, the temperature of the catalyst bodies (2*c*-5*c* to 3*d*-5*d*) increases as well. For this reason, the rate of the catalyst-based decomposition reaction accelerates and the oxidation of the components in the exhaust gas is greatly stimulated. Therefore, when the entire apparatus is made larger and the diameter of the current carrying bodies (2*a*-5*a*) increases, the contact of the exhaust gas with the discharge spark deteriorates and it is impossible to carry out complete processing of the exhaust gas using only the above-described spark discharge. The proportion of nonprocessed gas discharged from the discharge port (1*b*) as is, albeit insignificantly, does increase, but since the oxidative action of the above-mentioned catalyst is enhanced as well, the exhaust gas is completely processed and discharged from the discharge port (1*b*). Furthermore, because the current-carrying bodies (2*a*-5*a*) are electroplated with platinum, the oxidative action on the exhaust gas is further enhanced and exhaust-gas processing becomes even more complete.

Application examples are shown below. The internal diameter of the tube (1) is 100 mm; the current-carrying bodies (2*a*-5*a*) are cylindrical and made of copper electroplated with platinum with an external diameter of 60 mm and an internal diameter of 56 mm. Also, the cross-sectional area of the grooves of the conduits (2*b*, 4*b*) is 9.6 mm^2 with 12 grooves and the cross-sectional area of the grooves of the conduits (3*b*, 5*b*) is 16 mm^2, with six grooves formed therein. Furthermore, the distance between the

electrodes (2-3) is 28 mm, the distance between the electrodes (3-4) is 24 mm, and the distance between the electrodes (4-5) is /6 12 mm. Results obtained by carrying out processing at an applied voltage of 18 000 V, a discharge voltage of 6000 V, a discharge current of 80 mA, and an exhaust gas flow rate of 7.5 Nm^2/h are shown next.

Application Example 1

In the case of a gas containing 1000 ppm of hydrogen sulfide, no hydrogen sulfide was detected in the gas discharged from the discharge port (1*b*).

In addition, when a liquid obtained by washing the above-mentioned discharged gas with water and a liquid obtained by washing the inside of the tube (1) after the test were subjected to analysis together, the results confirmed the presence of sulfuric acid in an amount equivalent to the processed hydrogen sulfide.

In this connection, in the case in which the current-carrying bodies (2*a*-5*a*) were not electroplated with platinum and an ordinary insulating material that did not consist of a catalyst was used for the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*), the percentage of removal of hydrogen sulfide was about 97%.

Application Example 2

In the case of a gas containing 1000 ppm of methylmercaptan, no methylmercaptan was detected in the discharged gas.

In this connection, in the case in which the current-carrying bodies (2*a*-5*a*) were not electroplated with platinum and an ordinary insulating material that did not consist of a catalyst was used for the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*), the percentage of removal of hydrogen sulfide was about 98%.

Application Example 3

In the case of a gas containing 1200 ppm of sulfur dioxide, no sulfur dioxide was detected in the discharged gas.

In addition, when a liquid obtained by washing the discharged gas and a liquid obtained by washing the inside of the tube (1) after the test were subjected to analysis together, the results confirmed the presence of sulfuric acid in an amount equivalent to the processed sulfur dioxide.

In this connection, in the case in which the current-carrying bodies (2*a*-5*a*) were not electroplated with platinum and an ordinary insulating material that did not consist of a catalyst was used for the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*), the percentage of removal of sulfur dioxide was about 92%.

Application Example 4

In the case of a gas containing 11.0% of ammonia, no ammonia was detected in the discharged gas.

In addition, when the discharged gas was subjected to analysis, the results confirmed an increase in the amount of nitrogen, which was equivalent to the processed ammonia.

In this connection, in the case in which the current-carrying bodies (2*a*-5*a*) were not electroplated with platinum and an ordinary insulating material that did not consist of a catalyst was used for the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*), the percentage of removal of ammonia was about 95%.

Application Example 5

In the case of a gas containing 300 ppm of trimethylamine, no trimethylamine was detected in the exhaust gas.

In this connection, in the case in which the current-carrying bodies (2*a*-5*a*) were not electroplated with platinum and an ordinary insulating material that did not consist of a catalyst was used for the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*), the percentage of removal of trimethylamine was about 98%.

Application Example 6

In the case of a carbonic acid gas containing 2.5% of hydrogen sulfide and 0.5% nitrogen (in this case the flow rate of the exhaust gas was 3.0 Nm^2/h), no carbonic acid gas was detected in the discharged gas.

In addition, when a liquid obtained by washing the discharged gas with water and a liquid obtained by washing the inside of the tube (1) after the test were subjected to analysis together, the results confirmed the presence of sulfuric acid in an amount equivalent to the processed hydrogen sulfide.

In this connection, in the cases in which the current-carrying bodies (2*a*-5*a*) were not electroplated with

platinum and in which an ordinary insulating material that did not consist of a catalyst were used for the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*), the percentage of removal of hydrogen sulfide was about 97%.

Next, explanations are provided regarding the application example of Figures 8 and 9, in particular regarding the differences and similarities to the application example of the above-described Figures 1-7.

In this case, the catalyst bodies (2*c*-5*c*) and (2*d*-5*d*) do not consist of a catalyst, and are formed from ordinary ceramics. Also, there are round plates (25) (porous plates) having numerous holes (25*a*), whose construction is the same as that of the oxidation catalyst used in the above-described application example, with these plates (25), in other words, insulating oxidation catalyst bodies, interposed between the electrodes (4-5) and between the electrode (5) and the discharge port (1*b*) as shown in Figure 8.

Thus, the exhaust gas not processed by the spark discharge, is subjected to oxidation processing by the oxygen in the porous plates (25). In addition, in this case, because the porous plates (25) are provided between the electrodes (4-5) and between the electrode (5) and the discharge port (1*b*), the catalyst-based decomposition reaction can be carried out in an extremely vigorous manner.

Because other constituent elements of its operation are the same as in the above-described application example, they have been omitted.

All of the above explanations refer to application examples, for instance, there is no need to provide a total of four electrodes (2-5), and there may be only two electrodes (2) and

(5). Also, in the application example of Figures 8 and 9, there may be no porous plate (25) between the electrodes (4-5), and /7 there may also be no porous plate (25) between the electrode (5) and the discharge port (1*b*). Also, naturally, replacements of each component with equivalent parts are included in the technical scope of this invention.

As was described above, in the present invention, most of the exhaust gas introduced in a discharge field is subjected to dissociation and ionization by the contact with the discharge spark and is then oxidized by the accompanying oxygen, converting this to a harmless gas. Moreover, exhaust-gas components that have not been processed by the above-described discharge are quickly oxidized and converted to harmless gas by the oxidation catalyst bodies (2*c*-5*c*), (2*d*-5*d*), and (25) [sic], which are heated by the energy released during the discharge.

Brief description of the figures

Figures 1-7 show an application example of this invention. Figure 1 is an explanatory figure of the entire cross section of the main portion, Figure 2 is a view of a cross section taken along line II-II in Figure 1, Figure 3 is an oblique view of a vertical cross section of an insulating support in Figure 2, Figure 4 is a view of a cross section taken along line IV-IV in Figure 1, Figure 5 is an oblique view of an insulator in Figure 4, Figure 6 is plane view of a switch in a switching circuit in a voltage-applying circuit as well as its vicinity, and Figure 7 is a partically simplified view of a cross section taken along line VII-VII in Figure 6. Figures 8 and 9 are explanatory figures of vertical cross sections of main portions representing another

application example of this invention, with Figure 8 being an explanation of vertical cross sections of main portions and Figure 9 being a view of a cross section taken along line IX-IX in Figure 8.

In the figures:

1. Tube.
1*a*. Gas introduction port.
1*b*. Gas discharge port.
2, 4. First electrodes.
3, 5. Second electrodes.
2*a*-5*a*. Cylindrical current-carrying bodies.
2*b*-5*b*. Gas conduits.
2*c*, 4*c*. Insulating supports (in the application examples, insulating oxidation catalyst bodies)
2*d*, 4*d*. Insulators (in the application examples, insulating oxidation catalyst bodies)
3*c*, 5*c*. Insulators (in the application examples, insulating oxidation catalyst bodies)
3*d*, 5*d*. Insulators (in the application examples, insulating oxidation catalyst bodies)
C. Voltage-applying circuit.
S. Switching circuit.
20, 22. Switches.
23, 24. Insulating plates.
23*a*, 24*a*. Horizontal shafts.
25. Porous plate.

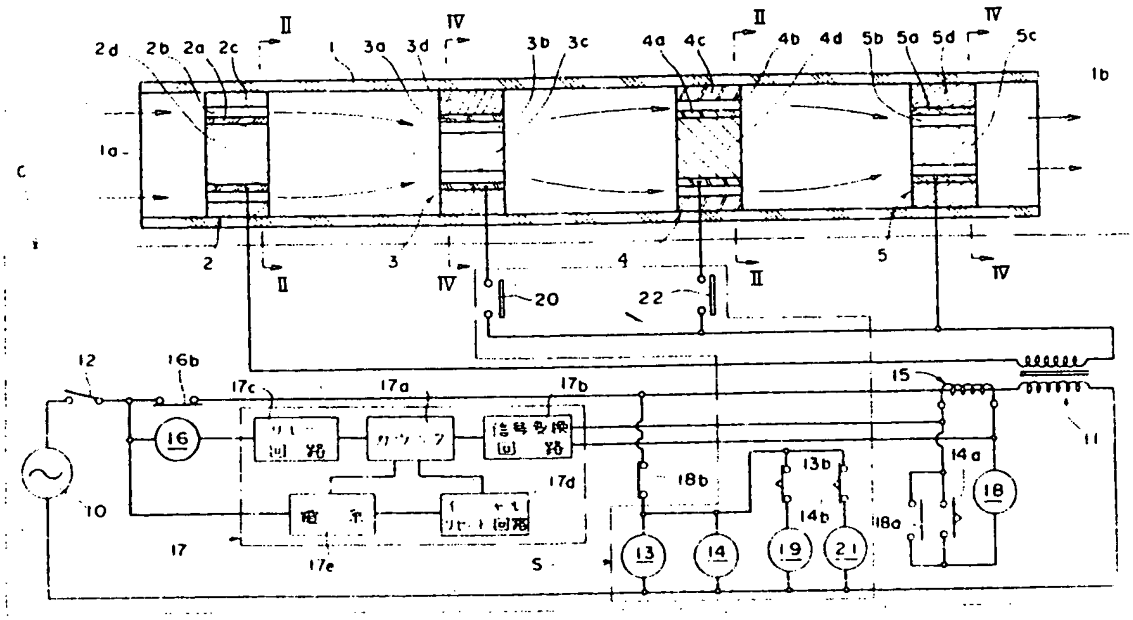

Figure 1

Key: 17a Counter
17b signal conversion circuit
17c Relay circuit
17d Initial reset circuit
17e Power supply circuit

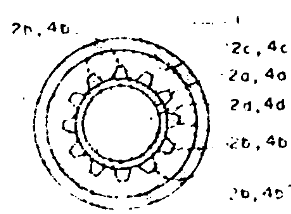

Figure 2

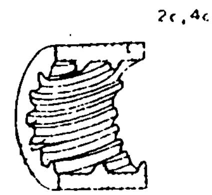

Figure 3

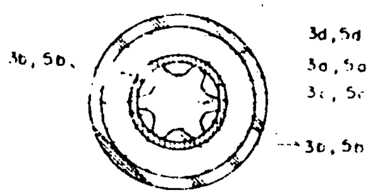

Figure 4

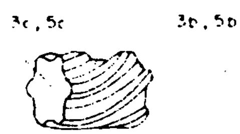

Figure 5

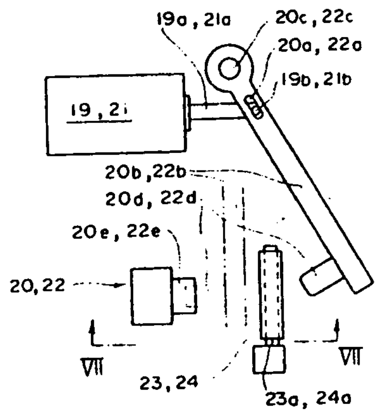

Figure 6

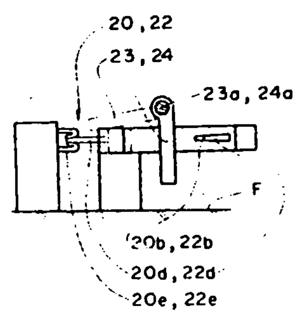

Figure 7

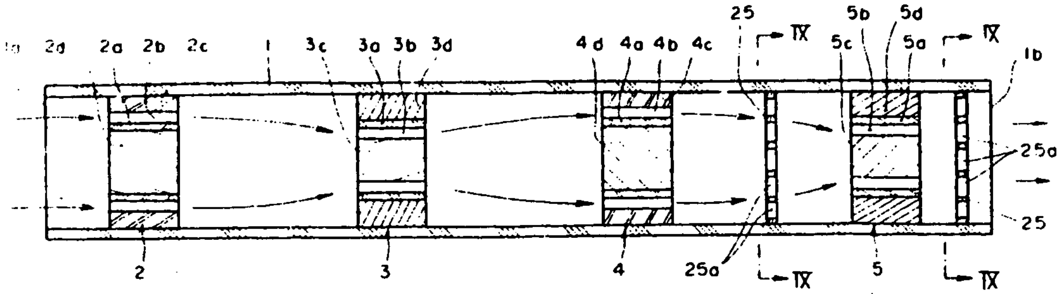

Figure 8

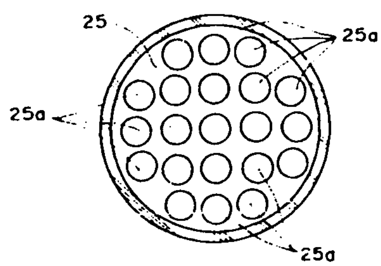

Figure 9

⑲ 日本国特許庁 (JP)　　⑪ 特許出願公開
⑫ 公開特許公報 (A)　　昭58—45718

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㊹排ガス処理装置

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明　細　書

1. 発明の名称

排ガス処理装置

2. 許請求の範囲

(1) 一端にガス導入口を、他端にガス排出口を形成した筒と、この筒内に間隔をおいて取付けた電極と、これら電極間に電圧を印加する回路と、前記筒内に設けた絶縁性酸化触媒体とを備え、前記電極は、その導電体の外周部にガス通路を形成した第1電極と、その導電体の内周部にガス通路を形成した第2電極とを含んでなる、排ガス処理装置。

(2) 前記電極は、少なくとも8個間隔を有して取付けられ、しかも前記第1および第2電極が交互に配列されてなり、また前記電圧印加回路には、前記電極のうち、前記筒の両端側のいずれか一方の電極とその他の電極との間において、順次遠隔する電極間に電圧を切換え印加するべくした切換回路が含まれてなる、特許請求の範囲第1項記載の排ガス処理装置。

(3) 前記絶縁性酸化触媒体は、多孔板に形成され、かつ隣接する前記電極の中間に介設されてなる、特許請求の範囲第1項記載の排ガス処理装置。

(4) 前記絶縁性酸化触媒体は、多孔板に形成され、かつ前記ガス排出口とこれに隣接する前記電極との間に介設されてなる、特許請求の範囲第1項記載の排ガス処理装置。

(5) 前記絶縁性酸化触媒体は、前記電極の絶縁支持材として形成されてなる、特許請求の範囲第1項記載の排ガス処理装置。

(6) 前記導電体は、白金メッキされてなる、特許請求の範囲第1項記載の排ガス処理装置。

(7) 前記各電極の前記ガス通路は、螺旋状に形成されてなる、特許請求の範囲第1項記載の排ガス処理装置。

(8) 前記螺旋状ガス通路は、その螺旋方向が隣接する前記電極ごとに交互に反対向きとなるように形成されてなる、特許請求の範囲第7項記載の排ガス処理装置。

3. 発明の詳細な説明

この発明は、有害、悪臭成分であるところの硫化水素、メルカプタン類、または二酸化硫黄などの硫黄化合物、あるいはアンモニア、トリメチルアミンなどの窒素化合物を含む排ガスを火花放電場において処理するべくした装置に関するものである。

前述のような有害、悪臭成分を含む排ガスを火花放電の行われている電場に導き、共存する気体と電気化学的に反応させて無害なガスに変換する排ガス処理装置としては、先に出願人は、特願昭55－11178号や特願昭55－34887号として出願している。即ち一端にガス導入口を、他端にガス排出口を形成した筒内に、導電体の外周部にガス通路を形成した第1電極と導電体の内周部にガス通路を形成した第2電極とを間隔を有して取付け、そして前記処理すべき排ガスを前記ガス導入口から導入し、前記ガス通路を経て前記ガス排出口から排出する間に、前記電極間に形成される放電電場を横切り、このとき前記排ガス中の各成分を電離、イオン化し、そして共存する酸素によって酸化して無害ガスに変換するべくしたものである。

前述のような処理装置の場合、とりわけ小型(直径が小)であれば、排ガス処理は効果的に行われるが、大型化すると排ガスと放電火花との接触が不十分となりその処理性能が低下する。

この発明は前述事情に鑑みなされたものであって、前述放電による排ガス処理装置の前記筒内に絶縁性酸化触媒体を設けて、処理装置が大型化しても処理性能が低下しないようにした排ガス処理装置を提供するのが目的である。以下実施例を詳述する。

まず第1～7図の実施例について詳述する。

1は、一端にガス導入口1aを、他端にガス排出口1bを形成した耐熱絶縁性の筒である。

2～5は、それぞれ筒1内に間隔をおいて取付けた実施例では4個の電極である。このうち2および4は、その導電体の外周部に右まわりの螺旋状のガス通路を形成した第1電極であり、それぞれ円筒状導電体2a、4aと、これら導電体2a、4aの外周部に一体に設けられ、かつ筒1に対する電極2、4の支持材でもあり、内周部に右まわりの螺旋状のガス通路2b、4bを形成した絶縁性酸化触媒体2c、4cと、導電体2a、4aの内周部に一体の絶縁材(絶縁性酸化触媒体)2d、4dとより構成されている。また3および5は、その導電体の内周部に左まわりの螺旋状のガス通路を形成した第2電極であり、それぞれ円筒状導電体3a、5aと、これら導電体3a、5aの内周部に一体に設けられ、外周部に左まわりの螺旋状のガス通路3b、5bを形成した絶縁材(絶縁性酸化触媒体)3c、5cと、導電体3a、5aの外周部に一体に設けられ、筒1に対する電極3、5の支持材でもある絶縁性酸化触媒体3d、5dとより構成されている。

そして各電極2～5は、第1電極2、4と第2電極3、5とが交互に配列されるよう、第1図のように一定間隔をもって直列状に設けられている。従って結果的にガス通路2b～5bは、隣接する電極ごとに反対向きに設定されていることになる。

なお導電体2a～5aは、例えば鋼や銅などの表面に白金メッキされている。また各触媒体2c～5cおよび2d～5dは、この実施例では、結晶質粘土鉱物と酸化亜鉛および酸化マンガン、あるいは、結晶質粘土鉱物と酸化亜鉛、または結晶質粘土鉱物と酸化マンガンで構成されている。前記結晶質粘土鉱物としては、非晶質であるアロフェンを除いた粘土鉱物が用いられるが、一般的には市販のカオリン、モンモリロナイト、ゼオライトが好ましい。また酸化亜鉛としては、特にその純度を要求されるものではなく、市販の ZnO が用いられる。さらに酸化マンガンとしては、MnO_2、Mn_2O_3 など通常の酸化物が用いられるが、少量の不純物を含むものであってもよい。そして例えば前述3成分を混合して触媒を構成するにあたっては、金属酸化物(ZnO、MnO_2として)を20重量%以上、結晶質粘土鉱物80重量%以下で混合され、各触媒体2c～5cおよび2d～5dは、それぞれの形状に成形され、200～600℃にて焼結されて形成されている。

Ｃは、電極２～５のうち、筒１の両端側のいずれか一方の電極（実施例では導入口１ａ側の電極２）とその他の電極３～５との間に電圧を印加するべくした回路である。以下この回路Ｃの構成を説明する。

１０は商用交流電源である。

１１は昇圧トランスであり、一次側１００Ｖ、二次側１８０００Ｖのリーケージトランスである。

１２は主スイッチである。

１３は限時継電器、１３ｂはその限時復帰のｂ接点であり、その限時動作時間は数秒に設定される。

１４は限時継電器、１４ａはその限時動作のａ接点、１４ｂはその限時復帰のｂ接点であり、その限時動作時間は継電器１３の限時動作時間の２倍に設定される。

１５は電流検出器である。

１６はリレーであり、１６ｂはそのｂ接点である。

１７はカウンタ回路であり、以下に説明する17ａ～１７ｅで構成されている。

１７ａはカウンタであり、ハイレベルの入力を４回入力するとハイレベルの出力を発生する。

１７ｂは信号変換回路であり、交流信号入力を整流し、レベルを調整してカウンタ１７ａの入力として適正な直流信号に変換するべくした、公知の回路である。

１７ｃはリレー回路であり、カウンタ１７ａのハイレベル出力により、リレー１６の帰路を開路するべくした、公知の構成の回路である。

１７ｄはイニシャルリセット回路であり、カウンタ回路１７への電源が一度、断になり再度、接になったときカウンタ１７ａをノーカウントの状態にリセットするべくした、公知の回路である。

１７ｅは電源回路であり、カウンタ回路１７への交流電源入力を整流し、レベルを調整してカウンタ１７ａ等の作動に適合した直流電源を得るべくした、公知の回路である。

１８はリレー、１８ａはそのａ接点、１８ｂはそのｂ接点である。

１９はソレノイド（常時突出型）であり、２０はソレノイド１９と連動する常開の開閉器である。

２１はソレノイド（常時突出型）であり、２２はソレノイド２１と連動する常開の開閉器である。

以上の１０～２２の構成は第１図のように接続されて回路Ｃが構成されている。

なお各ソレノイド１９、２１と各開閉器２０、２２とは第６、７図のように連結されている。すなわち長穴２０ａ、２２ａを有するレバー２０ｂ、２２ｂの一端を水平板Ｆ上に垂直軸支２０ｃ、22ｃし、長穴２０ａ、２２ａに各ソレノイド１９、２１のロッド１９ａ、２１ａが関着１９ｂ、２１ｂされている。そして各レバー２０ｂ、２２ｂの他端に雄端子２０ｄ、２２ｄが突設され、一方これに対応する雌端子２０ｅ、２２ｅは板Ｆ上に突設されている。また各レバー２０ｂ、２２ｂの回動領域内において絶縁板２３、２４（実施例では石綿板）が水平軸支２３ａ、２４ａにより吊下されている。そして各レバー２０ｂ、２２ｂは、通ソレノイド１９、２１に内蔵されたばねの力により第６、７図実線位置にあり、各端子２０ｄと２０ｅ、２２ｄと２２ｅはともに開の状態にある。また絶縁板２３、２４は、両端子２０ｄと２０ｅ間、２２ｄと２２ｅ間を遮断するごとく吊下されている。

そして継電器１３、１４およびそれらの接点13ｂ、１４ｂ、ソレノイド１９、２１およびこれらと連動する開閉器２０、２２により、筒１の両端側のいずれか一方の電極（実施例では電極２）とその他の電極３～５との間において、最初は電極２～３間、その後２～４間、最後は２～５間と、電圧を順次切換え印加するべくした切換回路Ｓとして構成されている。

さらにこの実施例の作用を述べる。

処理すべき排ガスを導入口１ａから導入すると、排ガスは螺旋状の通路２ｂ～５ｂを経由して第１図矢印の方向に筒１内を通過し、排出口１ｂから排出される。この間、通路２ｂ～５ｂの螺旋方向が右、左、右、左と隣接する電極ごとに反対向きになっているため、排ガスは、通路２ｂ～５ｂを

通過するごとに反対向きに旋回することになる。

そこで回路C中のスイッチ12を接にすると、継電器13、14、およびソレノイド19、21が作動する。すると両ソレノイド19、21のロッド19a、21aは、前記ソレノイド19、21内のばねの力に抗して没入し、レバー20b、22bは、第6、7図2点鎖線位置まで軸20c、22cまわりに回動し、端子20dは端子20eと、また端子22dは端子22eと、ともに接続され、開閉器20、22はともに閉となる。このとき両端子20d、22dまたはレバー20b、22bは、絶縁板23、24に当接、かつ絶縁板23、24を第7図2点鎖線のように軸23a、24aまわりに押上げることになる。すると導電体2a～3a間、2a～4a間および2a～5a間にそれぞれ高電圧が印加され、導電体2a、3aの相対する面の一部に放電が起こる。この放電は、前述の排ガスが電極2の通路2bを通って右旋回しながら流出するのに伴い、その放電点が右旋回することにより、導電体2a、3aの相対する面の全周にわたって行われることになり、放電火花の右旋回フレームカーテンを形成する。このため、通路2bから流出した排ガスは前記フレームカーテンを外から内へ確実に横切って、電極3の通路3bに流入することになる。この間に排ガス中の各成分は、電離、イオン化し、気中放電反応を行う。

そして継電器13の限時動作時間（数秒）経過後、接点13bが開となると、ソレノイド19は非作動状態となり、ロッド19aはソレノイド19内のばねの力により突出し、レバー20bは第6、7図実線位置に回動されて開閉器20は開となる。このとき絶縁板23は重力により第6、7図実線のように吊下状態となり、端子20dと20eとの間を遮断する。よって高電圧により端子20dと20eとの間で放電してしまうということはない。

次に前述開閉器20が開となると、電極2～4間に印加されている高電圧により、前述同様、導電体2a～4a間において放電が行われることになる。しかしながら、電極2～4間には電極3が存在しているため、実際には電極2～3間および、電極3～4間において前述同様、各電極を構成する導電体2aと3a、および3aと4aの両相対する面の全周にわたって放電が行われ、それぞれフレームカーテンを形成することになる。なお、導電体3aと4aとの間では、放電点は左旋回するので、これによるフレームカーテンは左旋回していることになる。よって電極3の通路3bから流出した排ガスは、導電体3a～4a間の左旋回フレームカーテンを内から外へ横切って、電極4の通路4bに流入することになる。そして電極2～3間で反応しなかった排ガスの成分は、電極3～4間で電離、イオン化される。

次に、継電器14の限時動作時間経過後、（継電器13の限時動作時間後数秒経過後）、接点14bが開となると、ソレノイド21は非作動状態となり、ロッド21aはソレノイド21内のばねの力により突出し、レバー22bは第6、7図実線位置に回動されて開閉器22は開となる。このとき絶縁板24は重力により第6、7図実線のように吊下状態となり、端子22dと22eとの間を遮断する。よって高電圧により端子22dと22eとの間で放電してしまうということはない。

次に前述開閉器22が開となると、電極2～5間に印加されている高電圧だけにより前述同様、導電体2a～5a間において放電が行われることになる。しかしながら、電極2～5間には電極3、4が存在しているため、実際には、電極2～3間、3～4間、4～5間において前述同様、各電極を構成する導電体2a、3a、4a、5aの相対する面の全周にわたって放電が行われ、それぞれフレームカーテンを形成することになる。なお導電体4aと5aとの間では、放電点は右旋回するので、これによるフレームカーテンは右旋回していることになる。よって電極4の通路4bから流出した排ガスは、導電体4a～5a間の右旋回フレームカーテンを外から内へ横切って、電極5の通路5bに流入するので、電極2～3間および3～4間で反応しなかった排ガスの成分は、放電電極

4～5間で電離、イオン化される。

前述のとおり、排ガスを連続して順次、火花放電電場に導き、放電火花との接触を極めて良好にして排ガス中の各成分を確実に電離、イオン化し、極めて効果的に、気中放電反応を行う。しかも排ガスは、各通路2b～5bを通過するごとにその旋回の向きが逆転されるので、放電火花と排ガスとの接触がさらに良好となり、前記電離、イオン化がさらに極めて効果的である。

そして継電器14の限時動作時間経過後、接点14aが閉となると検出器15の検出出力によりリレー18が作動し、接点18aが閉となって、リレー18は自己保持され、一方接点18bは開となり、継電器13および14への通電は断となる。

そしてもし前記放電中に、ガス流速の変化その他の要因により前記フレームカーテンが掻き消されて放電が停止した場合は、検知器15の検出出力がなくなるので、リレー18が非作動状態となる。このため、接点18bが閉となるので、再び継電器13および14が作動し、前述同様にして放電が再開される。

なお、最初の放電が行われたときに、検出器15の検出出力がカウンタ回路17に入力され、カウンタ17aは1回目のカウントを行なっており、放電停止後の放電再開時に2回目のカウントを行う。さらにまた、放電が停止したときにも、前述同様、放電を再開させる動作が行われ、カウンタ17aは3回目のカウントを行う。そして3回目の放電開始動作が行われたのち放電が停止したときには、前述同様、検出器15の検出出力がなくなり、リレー18が非作動状態となるため接点18bが閉となり、一旦継電器13および14が作動して検出器15は4回目の電流検出を行う。この出力がカウンタ回路17に入力されるとカウンタ回路17は4回、入力を受けたことになる。このためカウンタ17aは4回目のカウントを行い、ハイレベルの出力をリレー回路17cに与えるので、リレー回路17cはリレー16を非作動状態にする出力をリレー16に与える。したがって、接点16bが開となり、回路Cの主要部は非通電状態になるので、前述の自動的な放電開始動作は行われなくなる。

そしてスイッチ12を断にした後、放電停止原因を究明し、適切な処置を行なって、再びスイッチ12を接にすると、カウンタ回路17はそのイニシャルリセット回路17dの作動によりクリアな状態に復帰しているので、回路Cは前述同様、放電開始動作を行う。

前述放電によりイオン化された硫黄原子は、共存する酸素と結合し、3酸化硫黄となり、窒素原子は、窒素ガスとなって、排出口1bから排出される。従って有害、悪臭成分として、硫黄化合物を含む排ガス処理にあっては、生成した3酸化硫黄は水と結合して容易に硫酸となるので、排出口1bから排出したガスを水で洗浄すれば、無害なガスとして大気中に放出できる。また窒素化合物のみの場合は、そのまま大気中に放出できる。

なお前記放電の際、その熱エネルギーにより筒1内の温度が上昇し、応じて触媒体2c～5c、2d～5dの温度も上昇する。そのため触媒による分解反応速度が高められ、排ガス成分の酸化が良好に促進されることになる。従って装置全体が大型化して導電体2a～5aの径が大となると、排ガスの放電火花との接触が悪化し、前述火花放電だけでは十分な排ガス処理を行うことができず、未処理ガスのまま排出口1bから排出される割合が少しではあるが増加してしまうけれども、前記触媒の酸化作用も加わるので、排ガスは完全に処理されて排出口1bから排出されることになる。さらには導電体2a～5aには白金メッキされているので、排ガスの酸化作用がさらに促進され、排ガス処理はさらに完全となる。

以下に実験例を示す。なお筒1の内径は100㎜、導電体2a～5aは、それぞれその外径が60㎜、内径が56㎜とし、白金メッキされた鋼製円筒体とした。また通路2b、4bの各溝は断面積9.6㎠とし、その溝は12条とし、通路3b、5bの各溝は断面積16㎠とし、その溝は6条とした。さらに電極2～3間の距離は28㎜、電極3

～4間の距離は24㎜、電極4～5間の距離は12㎜とした。そして印加電圧18000V、放電電圧6000V、放電電流8.0mA、排ガス流量7.5N㎡／h、という条件下で、処理した結果を示す。

実験例(1)　硫化水素1000PPmを含んだ空気の場合、排出口1bからの排出ガス中に硫化水素は検出されなかった。

なお前記排出ガスを水で洗浄して得た液と、実験後筒1内を洗浄した洗浄水とを合せて分析した結果、処理した硫化水素と当量の硫酸の存在が確認された。

ちなみに導電体2a～5aを白金メッキせず、触媒体2c～5cおよび2d～5dを触媒でない単なる絶縁材とした場合は、硫化水素の除去率は約97％であった。

実験例(2)　メチルメルカプタン1000PPmを含んだ空気の場合、排出ガス中にメチルメルカプタンは検出されなかった。

ちなみに導電体2a～5aを白金メッキせず、触媒体2c～5cおよび2d～5dを触媒でない単なる絶縁材とした場合は、メチルメルカプタンの除去率は約98％であった。

実験例(3)　2酸化硫黄1[illegible]0PPmを含む空気の場合、排出ガス中に2酸化硫黄は検出されなかった。

なお排出ガスを洗浄して得た液と、実験後筒1内を洗浄した洗浄水を合せて分析した結果、処理した2酸化硫黄と当量の硫酸の存在が確認された。

ちなみに導電体2a～5aを白金メッキせず、触媒体2c～5cおよび2d～5dを触媒でない単なる絶縁材とした場合は、2酸化硫黄の除去率は約92％であった。

実験例(4)　アンモニア11.0％を含む空気の場合、排出ガス中にアンモニアは検出されなかった。

なお排出ガスを分析した結果、処理したアンモニアと当量の窒素の増加を確認した。

ちなみに導電体2a～5aを白金メッキせず、触媒体2c～5cおよび2d～5dを触媒でない単なる絶縁材とした場合は、アンモニアの除去率は約95％であった。

実験例(5)　トリメチルアミン800PPmを含む空気の場合、排ガス中にトリメチルアミンは検出されなかった。

ちなみに導電体2a～5aを白金メッキせず、触媒体2c～5cおよび2d～5dを触媒でない単なる絶縁材とした場合は、トリメチルアミンの除去率は約98％であった。

実験例(6)　硫化水素2.5％、窒素0.5％を含む炭酸ガスの場合（この場合の排ガス流量は3.0N㎡／H）、排出したガス中には硫化水素は検出しなくなっていた。

なお排出したガスを水で洗浄して得た液と実験後筒1を洗浄した洗浄水とを合せて分析した結果、処理した硫化水素と当量の硫酸の存在が確認された。

ちなみに導電体2a～5aを白金メッキせず、触媒体2c～5cおよび2d～5dを触媒でない単なる絶縁材とした場合は、硫化水素の除去率は97％であった。

次に第8、9図の実施例につき、特に前述第1～7図の実施例との相違点を説明する。

この場合、各触媒体2c～5c、2d～5dは、触媒ではなく、一般的なセラミックなどの絶縁材で形成されている。そして前述実施例で使用した酸化触媒と同じ構成で、多数の孔25aを有する円板25（多孔板）が形成され、この板25すなわち絶縁性酸化触媒体は、第8図のように電極4～5間と、電極5と排出口1bとの間とに、それぞれ介設されている。

従って火花放電により処理されなかった排ガスは、多孔板25の触媒により酸化処理されることになる。なおこの場合、多孔板25は、最も高温となる電極4～5間と、電極5と排出口1bとの間に設けているので、触媒による分解反応がきわめて活発に行われ得る。

その他の構成作用は前述実施例と同様であるので、その説明は省略する。

前述説明はいずれも実施例であり、例えば電極2～5は、計4個である必要はなく、電極2と5との2個であってもよい。また第8、9図の実施

例にあっては、例えば電極4～5間の多孔板25を施してもよく、電極5と排出口1bとの間の多孔板25を施してもよい。その他各構成の均等物との置換もこの発明の技術範囲に含まれることはもちろんである。

この発明は前述したように、放電電場に導入された排ガスは、放電火花との接触によりほとんど電離、イオン化され、そして共存する酸素により酸化されて無害ガスに変換される。しかもその放電の際の熱エネルギーにより加熱された酸化触媒体2c～5c、2d～5d、25により、前述放電により処理されなかった排ガス成分もすみやかに酸化され、無害ガスに変換される。

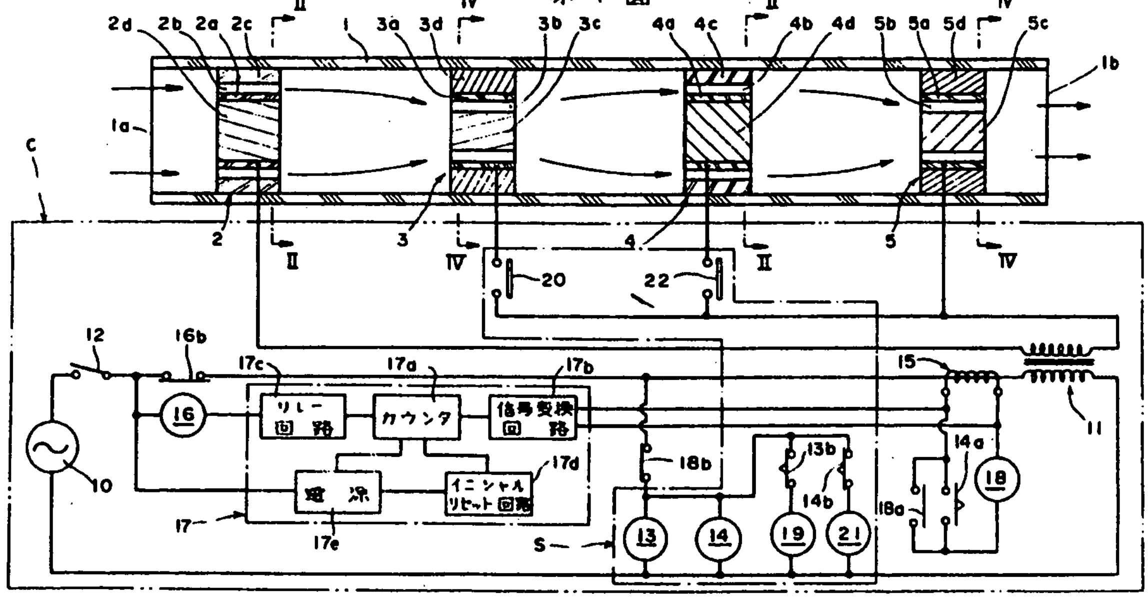
4. 図面の簡単な説明

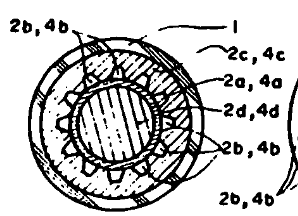
第1～7図はこの発明の一実施例を示し、第1図は要部縦断全体説明図、第2図は第1図のII－II断面矢視図、第3図は第2図における絶縁支持材の縦断斜視図、第4図は第1図のIV－IV断面矢視図、第5図は第4図における絶縁材の斜視図、第6図は電圧印加回路における切換回路の開閉器およびその近辺の平面図、第7図は第6図の一部省略VII－VII断面矢視図である。第8、9図はこの発明の別の実施例を示し、第8図は要部縦断説明図、第9図は第8図のIX－IX断面矢視図である。

図において、1…筒、1a…ガス導入口、1b…ガス排出口、2、4…それぞれ第1電極、3、5…それぞれ第2電極、2a～5a…それぞれ円筒状導電体、2b～5b…それぞれガス通路、2c、4c…それぞれ絶縁支持体（実施例では絶縁性酸化触媒体）、2d、4d…それぞれ絶縁材（実施例では絶縁性酸化触媒体）、3c、5c…それぞれ絶縁材（実施例では絶縁性酸化触媒体）、3d、5d…それぞれ絶縁支持材（実施例では絶縁性酸化触媒体）、C…電圧印加回路、S…切換回路、20、22…それぞれ開閉器、23、24…それぞれ絶縁板、23a、24a…それぞれ水平軸、25…多孔板（絶縁性酸化触媒体）、である。

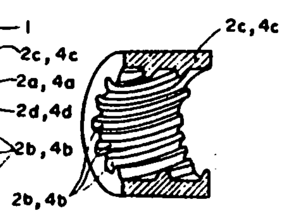
出願人 新明和工業株式会社
代理人 井上 正 （ほか1名）

第1図

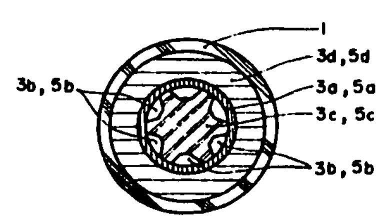




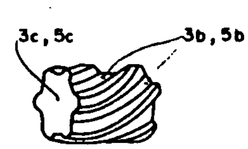
第2図



第3図

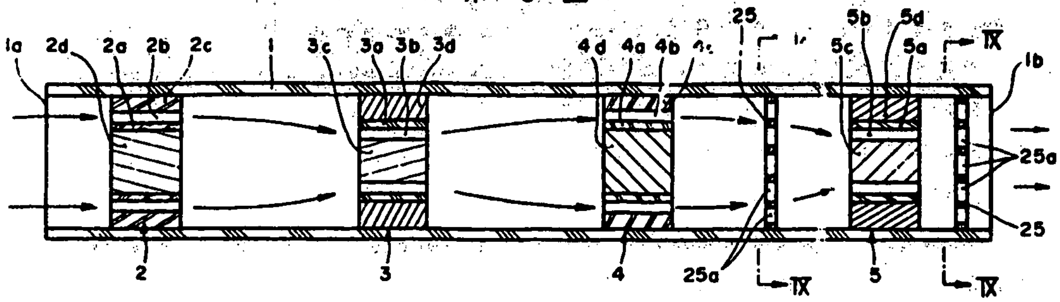


第4図

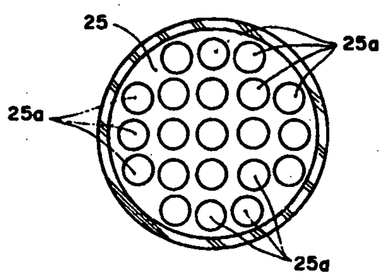


第5図

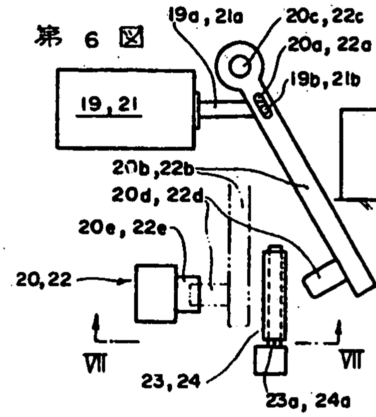
第 8 図



第 9 図



第 6 図



第 7 図